

wrong theories? In this candid book, Freese tackles these questions, beginning with the story of the research on this topic that she interweaves with her personal narrative. She was one of the first physicists to think about possible ways of detecting dark matter particles, and her story provides an interesting backdrop for the history of dark matter theories and experiments.

Although she has been involved in many aspects of developing theoretical models of dark matter particles, and in thinking of extraordinary way of detecting them (one using DNA strands!), her narrative is remarkably forthright. At the end of the book, after describing the present state of confusion among the scientists, she asks: 'Is it possible that dark matter and dark energy don't exist? Could scientists be missing something fundamental? Perhaps an entirely different way of looking at the world will replace the need for these invisible pieces of the Universe.'

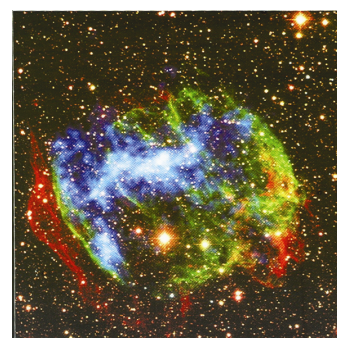
Currently, there are a number of ongoing experiments around the world, trying to look for the elusive dark matter particles. No one yet knows what properties (even mass) these particles may have, but as Freese's account tells us, there are some broad ideas. One is to use large particle accelerators, such as the one in CERN that discovered the Higgs particle, and hope that particle collisions would create some dark matter particles. Another idea is to use detectors of some special nuclei which may detect the dark matter particles that are swarming around the solar system in this part of the Milky Way. As the Earth goes around the Sun, these detectors are likely to show an annual modulation (although tiny in magnitude) of the detection rate. Freese was one of the first people to predict and characterize such an expected modulation. An Italian experiment claims to



The Cosmic Cocktail: Three Parts Dark Matter. Katherine Freese. Princeton University Press, 41 William Street, Princeton, New Jersey 08540, USA. 2014. xi + 250 pp. Price: US\$ 29.95.

Dark matter is an enigma of modern astrophysics. About a third of the total mass energy of the universe is believed to be made up of something that gravitates but does not shine. Another two thirds is thought to be composed of yet another intriguing substance called the dark energy. The type of matter that we normally encounter constitutes a tiny 4%.

Are these ideas for real, or do they represent a desperate attempt to explain the observations with incomplete or



A supernova remnant.

BOOK REVIEWS

have detected this modulation, but there are some doubts whether or not they are spurious signals. Yet another idea is to look for high-energy photons from astrophysical objects or regions (such as the centre of the Milky Way), which may result from interactions of dark matter particles with themselves or decaying dark matter.

Freese's account is partly at the level of popular science books, and partly a memoir. Her style of writing is engaging, and the anecdotes of conferences and meetings in which new ideas regarding dark matter have come up, make the narrative very readable. Barring a few typos (for example, HESS telescope is mistakenly noted as being located in Europe), this is an interesting addition to the list of books that tells the story of modern physics from the point of view of an active practitioner.

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